

# 29. Igneous microstructures from kinetic models of crystallization

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## Content of the paper

### Objectives

The objective of the paper is to aid with the deciphering of the contribution of each kinetic process (e.g. nucleation, growth, aggregation, grain boundary annealing) to the final microstructure, including the role of the intensive parameters (e.g. temperature, time) governing crystallization. The paper models how igneous rocks crystallize as a function of time.

### Research gap

The knowledge of crystallization kinetics of solidifying magmas at the time that the paper is published is mainly limited to relatively short duration melting experiments that are most applicable to rapidly cooled magmas (i.e. lavas) and not coarse-grained, slowly cooled igneous rocks. The paper tried to fix the aforementioned research gap by using a simplified model of crystallization. The model of crystallization used ignores any factors that would change the volume of the domain analyzed and crystal movement during crystallization due to mutual impingement or buoyancy forces.

### Methodology

The paper used a simplified model that uses the Avrami equation. This is a good choice for the model because the researchers were only concerned as to how the crystallization would form over time given certain initial conditions. One thing that they used is the use of computer modeling. The researchers also used a stochastic algorithm, an algorithm wherein the initial conditions are on some way random.

## Conclusion

The paper found out that an exponential nucleation rate with an exponential factor of 8 and constant crystal growth rate yields a microstructure that seems like the one often found for rocks. However, for exponential factors lower than 8, the model is less realistic in emulating nature.

The percolation threshold influences the onset of a finite yield strength and condition needed for interstitial flow of melt.

The advantage of simulating the microstructure is that samples of molten magma arrested in a natural state are rare. The simulated microstructures could also be used to obtain the macro-scale physical properties of magma on times where they could not be obtained using experiments.

## Relation of the paper to topics discussed in CEGEOLO

The relation of the paper is that the topic mentioned in the paper deals with the things that happens with igneous rocks and this paper looks at how the igneous rocks crystallizes due to kinetic processes. This topic is related to the discussion with regards to rocks and minerals because the paper concerns about the behavior of magma, a type of rock ejected from volcanoes.